REMARKS

Claims 1-4 are all the claims pending in the application. By way of this Amendment, Applicant has amended claim 1 and added new claims 5-8. For the following reasons, it is submitted that the application is in condition for allowance.

With respect to the §112 (second paragraph) rejection, it is submitted that the above amendment overcomes this rejection.

It is noted with appreciation that the Examiner has indicated that claim 2 contains allowable subject matter. On the other hand, claims 1, 3 and 4 have been rejected under §102(b) as being anticipated by JP 2002-181053 (JP '053). For the following reasons, Applicant respectfully traverses this rejection.

1. In general, a cylindrical roller bearing is configured in a manner that, in order to guide cylindrical rollers in the circumferential direction of a raceway ring, a flange portion is provided at the end portion of the raceway ring, and the end face of each of the rollers is made in slide contact with a roller guide-surface formed at the inner surface of the flange portion.

2. The present invention relates to a cylindrical roller bearing which is used for the transmission etc. of an automobile and durable to an excessive axial load applied thereto, and in particular relates to the improvement of a cylindrical roller bearing which has improved seizure resistance so as not to cause seizure immediately, even in a case of a high-speed rotation or a case of using low-viscosity oil or a case where a lubricating oil device is failed and lubricating oil can not be supplied sufficiently.

3. According to claim 1 of the present invention, there is provided a cylindrical roller bearing comprising an inner ring having an inner ring raceway surface, an outer ring having an outer ring raceway surface and cylindrical rollers each disposed between the inner ring

raceway surface and the outer ring raceway surface, wherein at least one of the inner ring and the outer ring has a flange portion provided with a roller guide-surface which contacts with and guides end faces of the cylindrical rollers. The cylindrical roller bearing is characterized in that:

for a diameter of the cylindrical roller is Da, the end face of the cylindrical roller away from a center axis of the cylindrical roller by 0.40 x Da in a radial direction is set as a first position, and the end face of the cylindrical roller away from the center axis of the cylindrical roller by 0.35 x Da in the radial direction is set as a second position, the end face of the cylindrical roller contacts with the roller guide-surface of the flange portion between the first position and the second position,

the end face of the cylindrical roller has a convex-shaped crowning portion formed by a continuous curve which passes the first position and the second position, and

an angle a formed between a straight line connecting the first position and the second position and a straight line perpendicular to the center axis of the cylindrical roller is set to be 0.5° or less.

4. According to the above configuration, a contact surface pressure at the contact portion between the roller guide-surface of the flange portion and the end face of the roller at the time of loading an axial load on the cylindrical roller bearing can be made relatively small.

5. Concretely, since a region between the first position A and the second position B on the end face 4a of the cylindrical roller 4 is set as a contact region where the roller guide-surface 7 of the flange portion 6 contacts with the end face 4a of the cylindrical roller 4, the contact region opposes almost the center portion in the thickness direction of the flange portion and so is located at the optimum position for pivotally supporting an axial withstand load.

The crowning portion 4b of the end face 4a of the cylindrical roller 4 is configured so as to be formed by the continuous curve which passes the two points of the first and second positions A and B and have the inclined angle a of 0.5° or less, whereby the contact surface pressure at the contact region in the case of acting an axial load thereon can be reduced and a PV value can be reduced. In this embodiment, the inclined angle α at the contact region of the end face 4a of the cylindrical roller 4 is set to be smaller as compared with the flange open angle θ of the roller guide-surface 7 so that the contact surface pressure is adjusted to be reduced depending on the relation between the inclined angle α and the flange open angle θ.

Further, according to the embodiment, a crowing portion is not provided at the entirety of the end face of the roller unlike the conventional technique, but only the region between the first position A and the second position B on the end face 4a of the cylindrical roller 4 is formed by the continuous curve, so that the processing time can be made short and the cost can be reduced. Furthermore, since only such the region is processed, the roughness thereof can be made good and the seizure resistance can be improved.

6. Further, according to claim 3 of the present application, there is provided a cylindrical roller bearing comprising an inner ring having an inner ring raceway surface, an outer ring having an outer ring raceway surface and cylindrical rollers each disposed between the inner ring raceway surface and the outer ring raceway surface, wherein at least one of the inner ring and the outer ring has a flange portion provided with a roller guide-surface which contacts with and guides end faces of the cylindrical rollers, the cylindrical roller bearing is characterized in that

the end face of the cylindrical roller has a convex-shaped crowning portion which contacts with the roller guide-surface when a load of a predetermined value or more acts, and

a radial direction distance h between the rolling surface of the cylindrical roller and a cross point where the end face of the cylindrical roller contacts with a phantom line along the roller guide-surface in a state where no load acts satisfies a relation of $h = Da / 2 - R' \times \sin(\theta)$ and $0.05\ (mm) \leq h \leq 0.5\ (mm)$, wherein Da represents a diameter of the cylindrical roller, θ represents a flange open angle of the roller guide-surface, and R' represents a curvature radius of the crowning portion.

7. According to this configuration, even when an axial load of a predetermined value or more is loaded on the cylindrical roller bearing so the contact portion shifts towards the peripheral surface of the flange portion due to the influence of the tilt, the contact portion is prevented from protruding from the roller guide-surface. Further, the contact surface pressure at the contact portion between the roller guide-surface of the flange portion and the end face of the roller can be made small.

8. Concretely, the cross point Q between the end face 24a of the cylindrical roller 24 and the phantom line C along the roller guide-surface 27 of the flange portion 25 in the state where no load acts is set on the lower side of the flange portion 25, that is, set so that the radial direction distance h of the cross point Q satisfies the formula (2). Thus, even when the tilt causes in the case where an excessive axial load of the predetermined value or more acts, the cross point Q generates the contact ellipse at almost the center of the flange height L or the lower side position from the center thereof and so actually contacts with the roller guide-surface 27. Thus, even when a high load acts, the PV value at the contact point can be reduced and so the seizure resistance can be improved.

9. On contrary, in the cited reference JP '053, the intersection position of the chamfering portion and the plane portion of the roller end face on the radial-direction small

diameter side in an outer ring flange portion and the radial-direction large diameter side in an inner ring flange portion, is placed rather than the intersection point of the flange surface and a relief portion for grinding

10. However, in the JP '053, the direction of the major axis of the contact ellipse caused at the contact portion between the roller and the flange portion is the radial direction of the inner ring of the bearing. Thus, the contact ellipse may protrude from the relief groove of the inner ring flange surfaced or the outer diameter of the flange surface depending on an amount of the axial load, so that an edge load is generated at the boundary surface between the contact ellipse and the relief groove or the boundary surface between the contact ellipse and the outer diameter portion of the flange portion.

11. Further, in the JP '053, in order to prevent the contact ellipse from protruding from the relief groove of the flange surface, it is considered to raise the center position of the contact ellipse which is the contact surface between the roller and the flange portion on the outer diameter side of the flange surface. However, in this case, since the slippery degree between the roller and the flange portion becomes large, a heat value increases, the temperature of the bearing increases, scoring or seizure etc. of the flange portion occurs,

12. The present invention relates to a cylindrical roller bearing which can improve a seizure property and improve an allowable rotation speed without increasing the size of a bearing. Therefore, the present invention differs from the cited references and patentably distinguishes thereover.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the

Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,

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